Measuring the Average Per-Day Net Benefit of Non-Consumptive Wildlife – Associated Recreation for a National Park: A Count-Data Travel Cost Approach

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Abstract. We applied count-data travel cost methods to a truncated sample of visitors, to estimate the average CS per each day of visit of an individual to the Peneda-Gerês National Park for the enjoyment of its natural facilities for recreation purposes. As the recreation demand was measured in number of days of stay in the park during one visit only, the behaviour of the dependent variable is very specific. To overcome this situation, we propose the use of altered truncated count data models or truncated count data models on grouped data because we found they were better adjusted to our data set. The average individual point CS per day is estimated to be €194 varying between €116 and €448, with Simulated Limits. This information is useful in the formulation of government policy relating directly to national parks and conservation and the determination of future natural park management. To our knowledge, this is the first attempt to measure the average recreation net benefits per each day of stay in a national park by using truncated altered and truncated grouped count data Travel Cost Model based on the observation of individual (not household) number of days of stay for one trip only.

Key Words: Consumer Surplus; Count Data Models; Non-Marketed Recreation Benefits; Travel Cost Model.

Abbreviations: Consumer Surplus (CS).

JEL classifications: C3; D1; D4; Q2.

This paper has not been submitted elsewhere in identical or similar form, nor will it be during the first three months after its submission to the Publisher.

I. Introduction

The Peneda-Gerês National Park (PGNP) was established in 1971 and is located in north-western Portugal. It covers 72,000 hectares and is the only National Park in mainland Portugal. It is a Specially Protected Site for Birds and included in the National List of Protected Sites (Net Nature 2000). The park is rich in rare botanical species and fauna. Park historical heritage ranges from prehistoric and Roman remains, medieval monuments, curious mountain agglomerates, and unique humanised landscapes like *lameiros* and *prados de lima*. PGNP experiences uneven recreation demand with a peak period during summer (July, August, and September), with August the month when recreation demand rises exponentially. During summer, there is excessive pressure from tourism and recreation visitors. PGNP is around 37 km away from the third national urban centre (Braga), 102 km from the second (Oporto) and 402 km away from the largest (Lisbon). There are no available statistics for counting or characterising recreation visitors. Like many others, PGNP faces a range of threats such as forest fires, human settlement inside the park and encroachment by local villagers, pollution and other threats to conservation created by visitors, particularly in summer. The overall negative impact of the above mentioned factors, along with insufficient funding, may have contributed towards mismanagement of the park. The government budget allocated for the management of PGNP and conservation in general is limited as it competes with other public programmes, such as education, wealth, infrastructures, or defence spending, etc. Any alternative source of funding for park management, entrance fees, does not exist at present. By showing that PGNP enables high non-market recreation benefits gives decision-makers and park managers a stronger economic justification to support the park and to divert scarce financial funds from other social investment alternatives. Results from recreation benefits can further be used in pricing and in incentive policies to develop sustainable but profitable activities like eco-tourism. In addition to a more efficient allocation of financial resources, such decisions would also contribute to the solution of certain key problems presently faced by this region: unemployment, rural desertification and excessive tourism pressure.

In this paper, we estimate the average monetary value the individual places on one recreation day, per season, in PGNP for the enjoyment of its unique and rare natural amenities and landscapes, by self-producing several recreation activities like camping, sight seeing, hiking, canoeing, and others. The economic measure of value is defined as the difference between individual willingness to pay and the actual recreation expenditure he/she makes in using the park's wild amenities for leisure and recreation purposes – the Consumer Surplus (CS) of the PGNP visitor. For this, the US Forest Service's basic recreation economic measure was adopted, where the standard unit is the CS per-activity day defined as one person's on-site CS for any part of a calendar day (Walsh et al 1990). The advantage of using this measure is that once a representative visitor's CS is estimated for recreating in a site, it becomes possible to obtain that visitor's CS for the site or any similar site, by multiplying CS per day of use by the number of days spent in recreation at the site under evaluation (Morey 1994).

To estimate the average marginal CS of the PGNP visitor, we used a single, on-site individual TCM model (Bell and Leeworthy 1990; Hof and King 1992; Font 2000) that predicts the number of days spent on-PGNP per visit, not number of trips, as a function of the price (cost) of each recreation day and of other visitor characteristics. The price (travel and on site cost) is assumed to be exogenous.

We opted for on-site sampling in order to guarantee gathering reliable responses in a short period of time and at a low cost and measured the dependent variable as the numbers of days of stay in the park per point of visit in the season. There are, however, several features with the nature of on-site sampling and the nature of the dependent variable worth mentioning: i) the dependent variable is a count data process which is observed truncated at zero; ii) the inexistence of endogenous stratification[1] because people were observed at the park entrance; iii) individuals revealed special preferences on specific number of stay days (like 8 or 15) inducing a particular behaviour of the dependent variable that cannot be well explained by common count data models like Poisson's (Shaw 1988) and Negative Binomial's (Long 1997; Grogger and Carson 1991). Therefore, we opted instead to use altered truncated count models or truncated count data models on grouped data in order to estimate recreation demand[2].

Besides estimating the non-marketed PGNP recreation benefits, we also seek to investigate how sensitive are the estimate coefficients and CS to these alternative count-data models. Furthermore, we analyse the precision of the estimated welfare measure with the calculation of approximated confidence intervals for CS by using both the Delta Method and the simulation method of Creel and Loomis (1991). We found that, by using the methodology based on alternative count data models, we gained in result robustness but lost in precision of CS estimates, leading to wider confidence intervals. The average individual point CS per day is estimated to be € 193.74 varying (with 90% of confidence) between € 41 and € 347 with the Delta Method and € 116 and € 448 with Simulated Limits.

Single site count data travel cost models became increasingly more common as economists have recognised that travel cost studies permit demand to vary according to the traits of individual participants or participant groups (Shonkwiller 1999). A number of recent studies applied count data models to recreation demand and welfare measures estimates: Shaw (1988), Creel and Loomis (1990; 1991), Grogger and Carson (1991), Gurmu (1991), Hellerstein (1991), Hellerstein and Mendelsohn (1993), Yen and

Adamowics (1993), Englin and Shonkwiller (1995), Bowker and Leeworthy (1998), Sarker and Surry (1998; 2004), Santos Silva (1997), Zawachi et al (2000), Bhat (2003), Crooker (2004); Englin and Moeltner (2004), Hellström (2005) and Santos Silva (2003) for business trips. However, none of them used count data TCM models to estimate the per visitor per day net recreation benefits supported by national parks by using altered truncated or truncated models applied to grouped data, having as their dependent recreation demand variable the number of days of stay during a single trip to a single site per individual.

The results in this paper are aimed at providing robust information about the extent of the net recreation benefits rendered by PGNP by using costless sample methods like on-site surveys. This information is useful in the formulation of government policy relating directly to national parks and conservation and to the determination of future PGNP management strategies.

This study makes three main contributions to the literature on recreation benefit valuation. First, we present estimates of the PGNP recreation use value by using a Travel Cost Method Approach. Secondly, we measure the average recreation net benefit per each day of stay, by using truncated altered and truncated grouped count data Travel Cost Models, based on individual (not household) number of days of stay observations, for one trip only. And thirdly, the results of the different count data models were tested to study their impact on estimated recreation consumer surplus and on the relationship between the dependent variable (number of days of stay in the park during one trip), the price recreation variable, and visitor characteristics.

The paper is composed of six sections. Following this Introduction, section 2 presents the models used for measuring recreational demand and welfare. Section 3 outlines the data and empirical issues while in section 4 the econometric specifications and estimations of the recreation demand function are detailed and discussed. In section 5, the point CS is estimated as well as the respective confidence intervals and finally, section 6 discusses results, their application for conservation policies and sets out the main conclusions.

II. The single-site travel cost model

The Travel Cost Method (TCM) provides a means to estimate a natural site's non-marketed recreational monetary value based simply on actual visitor behaviour and related individual expenditure on marketed commodities that are weakly-complementary with recreation activities at the site, as an indirect means of revealing individual preferences (Bockstael and McConnel 1999; Freeman 2003). The method establishes a relationship between the costs (the price) incurred by travellers to a site and the number of trips taken. This relationship is further exploited to derive Marshallian Consumer Surplus (CS) for access to the park for recreation experiences, by simply integrating the area under the demand recreation curve, between two levels of price (recreation costs): the actual and the choke price (the highest recreation cost that turns park recreation demand to zero). TCM assumes that visitors perceive and respond to changes in travel costs in the same way they would to changes in an entrance fee.

The general theoretical basis of TCM derives from the basic economic notion of an individual utility function subject to budget and time constraints. The preferences of the representative recreation seeker are represented by the utility function

$$U = U(q_1, d, q_2) \qquad (1)$$

where q_1 is the quantity of *numeraire* whose price is one; d is the number of visit days in the PGNP; and q_2 is the quality characteristics of PGNP ecosystems[3]. The representative visitor is subject to two constraints: budget and time. The income constraint is represented by the equation

$$y = wT_w = q_1 + pd \quad (2)$$

where y is the available income of the visitor; w is the market wage rate; T_w is time spent on work; and p is the price (recreation cost) of one day of visit paid by the individual. The variable p includes the monetary cost of both the trip and days in the park. Following Wilman (1987) we assume that $d = \sum_{i=1}^{n} j_i$ where j_i is the *ith* visit length and n is number of visits within a given period of time (season). We further assume that he/she only values the total number of visit days[4]. The time constraint is represented by the equation

$$T = T_w + T_d \qquad (3)$$

where T is total time available to the individual and T_d is the time spent in days of recreation in the park. The representative recreation seekers maximizes *(1)* subject to *(2)* and *(3)*, yielding a set of ordinary demand functions for marketed commodities and recreational activities. Thus, the individual demand function for recreation days in the park is,

$$d = f\left(p, y, q_2\right) \quad (4)$$

Simply integrating *(4)* between two prices (costs) yields the CS marshallian welfare measure, the amount by which an individual's willingness to pay for the good exceeds what the individual must pay for it:

$$CS = \int_{p^0}^{p^1} f\left(p, y, q_2\right) dp \qquad (5)$$

where p^0 is the present recreation price which is equal to the recreation seeker's total expenditure necessary to produce d at the present, and they may include trip and on-site expenditure in addition to the opportunity cost of time; p^1 is the choke recreation price, that is, the highest recreation price that turns PGNP recreation demand to zero. The measure *(5)* is the money measure of individual recreational benefit derived from PGNP use for such purposes.

TCM enables a measurement of *p* in the absence of markets and has proven the most popular revealed preference based approach over the past 30 years (Ward and Beal 2000) for placing values on recreational use of nature (see, for example, Hellström 2005; Earnhart 2004; Bhat 2003 and Hesseln et al 2003 for more recent publications). It is commonly applied in benefit-cost analysis, in natural resource damage assessments where non-marketed recreation benefits are important and in defining access and pricing policies for ecosystems (Parsons 2004). The wide variety of TCM models appearing in the academic and empirical literature are variants on the general structure of the model above in how the dependent variable and recreation demand are defined and measured, and the estimation strategy used (Ward and Beal 2000; Fletcher et al 1990). Although recreation demand for a site may be modelled as aggregate or market demand, the most common practice is to estimate the recreation demand of the representative individual and then to calculate aggregate value measures as the sum of the individual's recreation values (Freeman III 2003). This estimate of the PGNP visitor marginal CS was based on an on-site individual TCM empirical version (Bell and Leeworthy 1990; Hof and King 1992; Font 2000), where the dependent variable is number of days on-park during one trip, not number of trips, and because it uses on-site and travel out-of-pocket costs, as well as travel and on-site time opportunity costs, and not only travel costs. The visitor combines time and money to reach the site and to stay there and chooses the number of days per visit that minimize total travel and on-stay costs (Wilman 1987).

Since we only observed individuals actually visiting the park during one trip for at least one day only during the season, recreation demand in the sample is truncated. Therefore, recreation demand in the population, *d*, is a non-observable latent variable (see for instance Englin and Shonkwiler 1995) which relates to sample demand, say *ND*, by the following,

$$ND = d \quad if \quad d>0$$

where *ND* is a count variable truncated at zero. The usual approach (e. g. Sarker and Surry 2004; Englin and Shonkwiller 1995; Grogger and Carson 1991; Shaw 1988) considers recreation demand to follow truncated Poisson or Negative Binomial distributions with mean λ. By choosing the semi-log form, the i^{th} individual expected on-day site recreation demand can be specified as follows:

$$E(d_i \mid x_i) = \lambda_i = exp\left(\beta_0 + \beta_1 p_i + \beta_2 y_i + \tilde{\beta}\tilde{x}_i\right) \qquad (6)$$

where p_i is the Price/Recreation Cost of one visit day for visitor *i*, y_i the available recreation income of visitor *i*, $\tilde{x}_i$ a vector of individual characteristics and other variables that influence recreation demand faced by the i^{th} visitor, β_j, with j = 0,1,2 , and $\tilde{\beta}$ are unknown parameters, and x_i is the vector with all the explanatory variables p_i, y_i, and $\tilde{x}_i$. Observe that the unknown vector of parameters $\beta = (\beta_0, \beta_1, \beta_2, \tilde{\beta})$ refer to the population and it can be consistently estimated in the sample by using adequate truncated count data models (Englin and Shonkiller 1995; Grogger and Carson 1991), satisfying,

$$E(ND_i \mid x_i) = E(d_i \mid d_i > 0, x_i) = g(\beta x_i)$$

The CS of a given number of days of visit for the representative visitor can be obtained with *(5)* using recreation demand in *(6)* leading to (Hellerstein and Mendelsohn 1993),

$$CS = \int_{P_0}^{P_1} \lambda_i \, dP = -\frac{\lambda_i}{\beta_1} \qquad (7)$$

Following Yen and Adamowicz (1993), the CS per visitor per day (CS_D) is measured by,

$$CS_D = -\frac{1}{\beta_1} \qquad (8)$$

III. Data and Empirical Issues

Sample

Data were partially obtained from an on-site questionnaire inquiry of a population composed of Portuguese citizens aged over eighteen. 1,000 questionnaires were distributed to adult Portuguese citizens visiting the park throughout the 1994 summer peak-period months (July-September) for 24 hours or longer. To surround endogenous stratification related problems, visitors were interviewed at the moment of their arrival to PGNP campsite entrances. 41% of the sample individuals came from the two metropolitan areas- Lisbon and Oporto – with 86% declaring they were on holiday.

During summer season, visiting PNPG accounts for almost 90% of the total person-trips and person-days. Camping was considered the most relevant mode of lodging in order to avoid lodging utility generation. Endogenous stratification was circumvented by questioning visitors at the time they registered at the camping reception centres. Several individuals were dropped from the sample due to incorrectly completed questionnaires, resulting in 243 appropriated observations. Information collected focused on number of days of stay, visitor per-capita income bracket, place of origin, means of transportation, whether visiting independently or in a group, various demographic characteristics (gender, age, years of education, whether on vacation and total number of vacation days). Further questions focused on visitor perceptions on PGNP natural and humanised ecosystems and landscapes. Unfortunately, this last variable had to be excluded because a great majority of visitors did not adequately answer this category. Nevertheless, another questionnaire implemented by Santos J. M. L (1997) conclusively demonstrated that visitors broadly recognise specific PGNP characteristics with demand unambiguously related to them. We assumed that this visitor recognition is sufficiently strong so as to prevent consideration of any substitute for PGNP[5]. All monetary terms are calculated in 2005 euros.

Variables

We consider as explanatory variables the visitor's minimum recreation cost of each day of stay in the PGNP (including out-of-pocket travel and on-stay costs and travel and during-stay opportunity time), $[RCDS_i]$, individual per capita available recreation income, $[RY_i]$, number of available days to spend on recreation, $[ADR_i]$, age, $[AGE_i]$, and years of education, $[ED_i]$. Often *(6)* may also include the degree of perception the visitor has of natural park characteristics. However, for the aforementioned reasons, this variable was not included.

The dependent variable, $[ND_i]$, was measured by using the information directly reported by the visitor in the questionnaire. To determine the exogenous variable $[RCDS_i]$ we incorporated out-of-pocket travel and on-site costs as well as travel and on-site time opportunity costs (Bell and Leeworthy 1990, Hof and King 1992, Font 2000), and not only travel and opportunity travel time costs. The individual combines time and money to reach the site and to stay there and chooses the number of days per visit that minimises total travel and on-site costs (Wilman 1987) which we assume to be exogenous. To surround the difficulty related with the non-linearity of the budget constraint caused by the fact of time spent in the Park being taken as a variable affecting the dependent variable (see McConnell 1992), we assume fixed costs for each day of recreation in general, and fixed on-site and travel time cost in particular (Smith and al 1983; Wilman 1980; Wilman 1987). This means the marginal cost of one day of recreation in the park during one visit is assumed to be constant, which seems reasonable because: i) if the visitor decides to stay one more day he/she has no additional travel costs; ii) the on-stay costs are minimum and there is no fee; iii) the marginal cost only depends on the on-site time opportunity cost, which is assumed to be constant in our approach. Therefore, the minimum cost of one day of stay in the park (in 2005 euros) for individual *i* was calculated by the formula,

$$RCDS_i = \frac{RTC_i}{MDE_i} + OCDS_i + TC_{ti} + TC_{si} + PEF$$

$[RTC_i]$ is the roundtrip travel cost in euros[6]. For private vehicles, it is equal to the per km cost[7] multiplied by the number of km[8] travelled. For public transport, it is equal to the fare paid by the respondent. $[MDS_i]$ is the mean number of days the visitors travelling from the same geographical district as visitor *i* stayed in the park[9]. $[OCDS_i]$ is the on-site cost in euros per each day of stay[10]. $[TC_{ti}]$ and $[TC_{si}]$ are the opportunity costs of travel in euros and on-site stay time per visitor per day[11] respectively, quantified in costs in euros per each hour expended on the trip and on the stay. The cost in euros was assumed to be the same whether expended on travelling or on staying[12] and equal to one-third of the visitor's per capita per hour available recreation income measured in euros. We partially based this on the opportunity travel and on-site time cost valuation method more commonly used in TCM literature (Smith et al 1983; Wilman 1980), where travel and on-site time costs[13] are one-third of the wage rate (Bockstael et al 1987; Chakraborty and Keith 2000). However, instead of the wage rate, we used one third of the visitor's per capita per hour available recreation income measured in euros[14]. Travel time was exogenously estimated by dividing the km travelled by the visitor from place of residence to the park, and back, at the maximum speed legally allowed in Portugal (120 km/h on motorways and 90 km/h on other roads in the case of private vehicles). For public transport, we considered as time travelled the time between departure and arrival of the respective means, multiplied by two. In the case of the time spent on site, we used the reported number of days of stay in the park, but only the number of waking hours in a typical day of recreation in a protected area was considered, in other words, 16 hours (Walsh 1986). We further considered two other alternative methods of quantifying the travel and on-site cost of time[15] but the results for the parameter associated to the variable of price/recreation cost did not change much. $[PEF]$ is the park entrance fee which is zero at the present. $[RY]$ is also exogenously estimated since the reported net income was assumed to be equal to the 14 monthly payments normally received by employees in Portugal[16]. The other explanatory variables like $[ADR]$, $[AGE]$, and $[ED]$ were quantified directly from questionnaires. Descriptive statistics from the data set are presented in *Table I*.

[Table I]

During the peak summer season, PGNP visitors stayed in the park for 5.284 days on average. The variance of the dependent variable is high, 12.766 (much higher than the empirical mean), meaning the equidispersion property of the standard Poisson model may not hold.

Table II contains the frequencies of $[ND_i]$.

[Table II]

Clearly, the data do not exhibit any quick process of decay with more than one half of the sample visitors making visits of between one and six days. About 10% made one-day visits, 16% two-day visits, 10% three-day visits and so on. About 11% made eight-day visits, around 5% made ten-day visits and 3% fifteen-day visits. However, and as previously stated, common Poisson and Non-Negative Binomial models are not the most useful for regressing $[ND]$, because the behaviour of this variable is very specific:

figures show that 2, 4, 8, 10 and 15 day visits are more frequent than the neighbouring values, inducing potential problems for standard count data models in sufficiently adjusting to this specific behaviour of our dependent variable. The choice of such figures may represent, in part, individual preferences but may also be due to measurement errors in the sense that people are unable to exactly report the number of days of their stay but instead provide a close round number. For example, in Portugal people frequently refer to a week as 8 days and a fortnight as 15 days.

IV. Econometric Model Specification and Estimation Results

a. Literature Survey

A number of recent studies apply count data models to recreation demand and welfare measure estimates. Shaw (1988) was the first not only to recognise the non-negative integers, truncation and endogenous stratification characteristics of on-site sampling recreation data but also to assume that the use of common regression linear methods with this type of data samples generates inefficient, biased, and inconsistent estimations. He developed a truncated Poisson model (TPOIS) that corrected the sampling problems and captured the discrete and nonnegative nature of the dependent recreation demand variable allowing inference on the probability of visit occurrence (see also Creel and Loomis 1990; Gurmu 1991). Grogger and Carson (1991) found that the standard negative binomial model (NB) corrects for over dispersion, a very frequent statistical phenomenon not captured by the standard POIS. Furthermore, Gurmu and Trivedi (1994) noted that empirics demonstrated that a vast majority of visitors make at least one or two trips and that the number of recreational trips higher than two falls rapidly when the dependent variable is measured in number of trips to the site. This is called a fast decay process, a common characteristic in recreation-demand setting, and results in over dispersion. Sarker and Surry (2004) proved that the NBII model is capable of fitting a fast decay process. Englin and Shonkwiller (1995) developed a truncated negative binomial (TNB) model that corrects for both endogenous stratification and truncation. For recent developments in count data models applied to recreation, see Sarker and Surry (2004). Those further applying count data models to recreation demand functions and related welfare estimations based on individual TCM versions include Hellerstein (1991), Creel and Loomis (1990; 1991), Hellerstein and Mendelsohn (1993), Yen and Adamowics (1993), Bowker and Leeworthy (1998), Sarker and Surry (1998;2004), Santos Silva J.M.C. (1997;2003); Zawachi et al (2000); Bhat (2003); Crooker (2004); Englin and Moeltner (2004); Hellaträm (2005). Within the EU, several studies have been implemented since the last decade of the 20th century to estimate the use and the non-use values of ecosystems and national parks, but only eight used TCM, and none used count data models.

b. General Econometric Approach

As pointed out in the last section, we measured the dependent variable as the number of days of stay in the park per point visit per season to surmount the problem of working with a non-homogeneous dependent variable, as would happen if we instead used the number of trips, because there are one-day trips, two-day trips, and so forth: a marginal CS valuation based on a demand that ignores the non-homogeneity of trips in terms of overnight stays is not economically correct. As a consequence, our dependent variable has some specificity such as, and for instance, certain figures are more preferred than the neighbouring ones, which may be due to the holiday season or weekend effect, reinforcing the inadequacy of standard count data models for our study. Therefore, we chose two other more flexible and general count data specifications to start with: the

Truncated Generalised Poisson (TGP) and the Truncated Generalised Negative-Binomial (TGNB). The other specifications considered are obtained from these.

The Generalised Poisson (GP) given in Santos Silva (1997) verifies,

$$Var(d \mid x) = E(d \mid x)\left[1+\alpha E(d \mid x)\right]^2$$

with $E(d \mid x)$ as in *(6)* and α equal to,

$$\alpha = exp\left(\gamma_0 + \gamma_1 RCDS + \gamma_2 RY + \gamma_3 ADR + \gamma_4 AGE + \gamma_5 ED\right) \quad (9)$$

with γ_j, j = 0, …,5 unknown parameters to be estimated together with β. The Standard Poisson model is nested in the GP and its adequacy can be tested as shown in Santos Silva (1997). The second model considered is the Generalised Negative Binomial (GNB) with

$$Var(d \mid x) = E(d \mid x) + \alpha E(d \mid x)^2$$

We have considered some altered versions of these models by changing the probabilities of certain figures. Finally, we have also defined the appropriate specifications of these models for grouped data.

The truncated specifications of all the models considered were estimated by Maximum Likelihood (ML) using TSP 4.5. Robust standard errors were computed using the Eicker-White procedure. The RESET test was calculated to test for variable omission and nonlinearities of $\beta' x$ in *(6)* and $\gamma' x$ in *(9)*. Therefore to perform this test, the variable $\left(\hat{\beta}' x\right)^2$ was added to *(6)*, $\left(\hat{\gamma}' x\right)^2$ was included in *(9),* and the extended model was estimated by ML. Hence, the null that both coefficients of the new added variables are jointly zero is tested and its rejection shows evidence of misspecification. The adequacy of Poisson specifications were compared with the corresponding alternative Negative Binomial using the non-nested hypothesis tests of Santos Silva (2001) and

Vuong (1989). Following the last author, a non rejection in the test proposed induces that both models are equivalent but most probably ill-specified. Rejection of the test gives information about which model is appropriate depending on whether the test statistics turn out negative or positive. The approach of Santos Silva (2001) is rather different because it explicitly tests under the null one model against the other in the alternative. Therefore, the test has to be applied in both directions and the final conclusion combines the result obtained in each application.

We expected demand for PGNP recreation days per trip to be negatively correlated with the on-site daily recreation cost and with age, and positively correlated with the available recreation income, the available time for recreation activities and the level of education. All estimations, the price/recreation cost, the available income and the available recreation day variables, register the expected signs. The expected number of recreation days spent in the PGNP per trip goes down with higher recreation costs and up with higher available recreation income and time. The estimate of the [AGE] coefficient produces the expected sign, but the estimated effect of the variable $[ED]$ does not: however, both are not significantly different to zero.

c. Model selection

Since some of the parameters in the function α (that reflect the existence of over dispersion) were significant in the TGP and TGNB it leads us to conclude that the truncated Standard Poisson and truncated NB regressions are not suitable. Moreover, we have applied the Santos Silva (1997) test to evaluate the adequacy of the Truncated Standard Poisson obtaining a test statistic of 4.72 indicating its rejection. These results confirm our early conclusions drawn from analysis of the descriptive statistics presented in *Table I*. The results of the non-tested specification tests of Vuong and Santos Silva included in the *Appendix* show the inadequacy of both TGP and TGNB. Most certainly, such inadequacy is related with the weird behaviour of the dependent variable frequencies.

Since there are some peaks in visit days like 2, 4, 8, 10, and 15 it suggests modifying the probabilities of the TGP and TGNB in order to increase the probability of these days making the necessary transformation for the other probabilities simply to guarantee that the usual properties of probability functions are verified. Winkelman (2003) applies this procedure to a standard Poisson. To deduce it for the TGP and TGNB proved straightforward. It is not wise to alter the probabilities of all the figures mentioned because it will result in too many parameters to be estimated given the number of observations. We have chosen to alter only at 8 and 10 because those were the figures where the frequency peaks were relatively more important. However, the latter was not statistically significant. Results set out in the *Appendix* concerning the application of the non-nested hypothesis tests show the inadequacy of the altered models comes in at 5%.

The inadequacy of the altered models may suggest that the behaviour of the probability function of daily recreation demand may be too complex to be approximated by these known models. Given that the number of sample observations is not too large, it would be unwise to insert more structural parameters in the models because the respective estimates would hardly be statistically significant. A better solution is to group data in order to ensure the probability function of the grouped data becomes more regular, and consequently, easier to adjust by a simple model.

Looking again at *Table II,* we can classify the preferences as regards the number of visit days into roughly three major groups. The first group includes 151 individuals that visited the park from 1 to 5 days; a second group has 73 individuals with visits that range from 6 to 10 days and a third group with 19 observations made up of individuals visiting the PGNP for more than 10 days. With this approach we lose information because we will not use the exact observed values to build up likelihood but only the information from the group to which each belongs. However, this information is more robust and reliable for estimating the coefficients of the demand function and consequently the CS.

The non-nested hypothesis tests in the *Appendix* do not reject the adequacy of the TGP for grouped data.

d. Estimation Results for Grouped Data

We include only the results concerning the estimation of the TGP and TGNB models for the grouped data (respectively GTGP and GTGNB) for the sake of simplicity. Those can be found in *Table III,* which also includes estimates for their restricted versions.

Contrary to the other specifications also considered in this study, we now verify the existence of clear differences in the estimates returned by each grouped model, namely for the coefficients of the price proxy variable and recreation income. In the GTGP the coefficient estimate for this variable is not statistically significant though its value is around triple that of the respective estimate of the non-grouped TGP. Given the economic importance of this variable, we opted to estimate a restricted version of the last model that includes it, the RGTGP I. However, it was still not statistically significant, which led us to estimate the RGTGP II that excludes it from the regressors, inducing just a small variation of the price proxy coefficient estimate. There are also differences in the specification of the α function given that it includes recreational income in the GTGP and the price proxy in the GTGNB while in all models for non-grouped data they were absent from the variance function. The fact that these variables are now influencing the variance may explain their distinct behaviour on the mean function of the grouped data relative to the non-grouped.

[Table III]

The RESET test gives evidence of misspecification of the GTGNB whether for RGTGPI and RGTGPII and does not reject the hypothesis of no misspecification at the 5% level. We opted for RGTGPII instead of RGTPI for the sake of efficiency. Indeed, RGTGPII can be considered an acceptable model to estimate the CS in the sense that it has passed all tests of misspecification used and is therefore better adjusted to the data.

V. Point and Confidence Interval Estimates for CS

The Marshallian CS provides an approximation of the welfare associated with visiting the PGNP. Following Willig (1976), Randall and Stoll (1980), and Hanemann (1999), it would be possible to estimate Hicksian measures of recreation value like the willingness to pay an equivalent amount (Mäler 1971; 1974), by using Marshallian CS estimates, which is a common practice in academic literature. However, Englin and Shonkwiller (1995) showed that visitor Hicksian welfare measures of one average length day-of-stay visit depend upon individual socio-economic characteristics. The usual approach extrapolates these measures for the average individual in a population based on estimated measures for the population sample. However, we could not proceed in the same way because we used an on-site truncated sample of individuals that actually visited the site and therefore their characteristics are not representative of those of the Portuguese population, which also includes individuals with zero visits. Hence, we instead based our recreation value measure on the Marshallian CS_D because this indicator depends only upon an unknown parameter of the population which can be consistently estimated with the truncated sample by using the appropriate models.

The point estimates of the CS_D obtained according to *(8)* are given in *Table IV*. In order to provide a comparison, calculations are done for restricted versions of all models previously detailed though our preference goes to the RGTGPII (for grouped data).

[Table IV]

CS_D reveals some sensitiveness to estimation procedures, particularly in the RGTGNB. Confidence limits for CS_D are not so straightforward to obtain given that it is a nonlinear function of a parameter. The standard approach is to use the Delta Method. Creel and Loomis (1991) propose constructing approximate confidence limits based on simulating from the joint asymptotic Normal Distribution of the ML estimator for β with mean vector and covariance matrix generated by ML estimates. We have obtained confidence limits using both methods. Their accuracy depends on the accuracy of the asymptotic normal distribution in approximating the true distribution of the estimator. Here, given the fact that the sample size of our data is not large, results should be interpreted with caution. Simulated confidence limits were obtained considering one million draws. Results follow the common characteristic of those obtained from truncated estimators (Yen and Adamowicz 1993): larger consumer surplus estimates with wider confidence intervals. Simulated confidence limits have a tendency to be higher than the respective limit obtained with the Delta methods for all models. Considering more flexibility in estimation bears the cost of a loss in precision leading to wider confidence interval, however, there is a gain in result robustness. Narrow confidence intervals with incorrect information are indeed useless. Particularly, our preferred model, the RGTGPII, produces the widest intervals compared to the other specifications: CS_D varies from €116 to €448 with simulated limits, €41 to €345 with the Delta method, and the point CS_D is €194 but we believe that these estimates are more robust than those estimated by the other models. This variance may not be seen as a surprise caused by grouping the data, which is the equivalent of censoring, while there is somehow a loss of information. In spite of this, the censored data gives more reliable information that can be better handled by a count data model, where the dependent variable is number of days of stay during a point trip to a natural area. The major conclusion, however, is while confidence limits are somehow apart they do not include the zero. Therefore, we can reject the hypothesis that CS_D is null for the PGNP.

VI. Discussion and Conclusions

In this paper, we seek to measure the average per-day recreation net benefit of non-consumptive wildlife associated recreation access to the PGNP, defined as the amount of money an individual is willing to pay for recreation services produced in the park that exceeds what the individual must pay at present to benefit from those recreation services in the park. To estimate the average marginal CS of a PGNP visitor, we used a single, on-site individual TCM model that predicts the number of days spent in PGNP per visit as a function of the price (cost) of each recreation day, and of other characteristics of the visitor. The price (recreation cost) variable includes on-site and out-of-pocket travel costs, as well as travel and on-site time opportunity costs, and not only travel costs. These data were used to estimate the coefficients of a demand function for recreation days where we propose the use of altered truncated count models and truncated count data models on grouped data to estimate recreation demand instead of standard count data models. We found the truncated Poisson on grouped data – RGTGPII, more adequate to our data in the sense that it passed all the misspecification tests applied while others revealed evidence of misspecification. The inverse of the estimate of the price/recreation variable coefficient for the recreation demand function was further exploited to get the Marshallian Consumer Surplus per each day (CS_D), per visit, for individual access to the park for recreation experiences. We obtained the following results. One recreation day in the PGNP at the time of the questionnaire was worth €193.74 (2005 prices) per visitor and varies (with 90% of confidence) between €40.68 and €346.80 with the Delta Method and € 116 and € 448 with Simulated Limits. In choosing the RGTGPII as the most adequate to estimate CS_D, we gained in the robustness of these results but somewhat lost out in precision, leading to wider intervals. However, narrow confidence intervals with wrong information prove of no purpose. Estimates vary according to the model used which is not unusual in TCM approaches. The greatest variations are unsurprisingly revealed by the grouped models because when grouping data, equivalent to censoring, information is somehow lost, but that remaining is rendered more reliable.

Two main problems were faced: the problem of the on-site sample versus extrapolation of the sample estimates involving characteristics individual to the overall population and the problem of the dimension of the sample versus the need to use more complex truncated count data, given the specificities of the behaviour of recreational demand in the sample. A compromise solution for this last issue was found by grouping the data. Furthermore, the idea of using the number of days of stay during one main season trip as the dependent recreation variable worked pretty well. Our strongest conclusion is that CS_D, per individual, is confidently different from zero and significantly higher than what each visitor actually pays to use the PGNP beyond travel and on-stay expenses, *i.e.*, €0. Our CS_D estimates are not comparable with others because, to our knowledge, there are no other similar applications whose results can be directly compared to these. However, we can confirm they do not differ significantly from other wildlife associated recreation activity CS or wildlife associated recreation CS for national parks or other ecosystems, while it is clear that more research is necessary and subject to the usual case-study caveats. For instance, Bowker and Leeworthy (1998) found that CS per trip associated with natural resource based recreation in the Florida Keys is $757 for white visitors and $121 for Hispanic visitors. Sarker and Surry (1998) found that CS per moose hunting trip varies between $175 (truncated Geometric Count Data Model) to $210 (Creel and Loomis models). Baht (2003) found that CS_D per person value for recreation activities in the Florida Keys Marine Reserve is \$122. Point CS_D estimates of €193.74 per person in the PGNP may be felt by some as being unrealistically high, in the sense that if the visitor would be hypothetically asked about the maximum amount of money he/she would be willing to pay to maintain his/her right to use the park for recreation, perhaps the answer would be closer to the lower boundary of the CS confidence interval, rather than the point's. However, we must remember that welfare money measures estimated through Travel Cost methods are based on real, not hypothetical, market expenses effectively supported by visitors. As we know and is largely confirmed by practice and theoretically sustained, individuals have hardly any clear perception of the true expenses they have to incur to gain some natural resource based commodity, while adopting very conservative behaviours when directly challenged about their willingness to pay for them.

Our model estimates that if some person with the average characteristics observed in the sample visits the park, there is an average stay of 4.51 days, giving a CS per visit of €873.77 (4.51 × €193.74), varying between €183.47 and €1564.07 with the Delta Method or between €522.93 and €2021.07 with Simulated Limits. To gain a more precise idea about the values involved, approximately 12,000 visitors were camping in the PGNP generating a recreational value per day of visit of €2,324,880 (12,000 × €193.74), and assuming an average 4.51 day visit, a value of €10,461,960.

Making broader predictions for the entire population as to these values is not straightforward. As already stated previously in the paper, though the parameter estimators of the recreation demand are consistent for the population, it does not guarantee that the representative visitor of our truncated on-site sample is representative for the population as a whole. In other words, the sample's average person may be considered as representative of those actually visiting the park but not the Portuguese population as a whole. Therefore, we would need to estimate the probability of an individual from the broader population visiting the park but there is no data available for such a purpose. Meanwhile, we can only speculate about this value creating different scenarios to estimate the monetary recreation value magnitude. For instance, if 1% of those aged 18 or over went to visit the PGNP, a €13×10^6 $(70,262 \times 193.74)$[17] total present use benefit per day would be generated, while 25% would generate total present use net benefit of €272×10^6 $(1,405,240 \times 193.74)$[18] per day. Applying the same rational to half of the aged 18 or over population, one day of PGNP recreation is worth a value equivalent to almost half that of Lisbon's Vasco da Gama Bridge, clearly a valuable asset for society.

Such results provide decision-makers with valuable information on the real value of the park. They indicate that PGNP visitors seemed to receive a considerable amount of benefit from recreational use of the park enabling us to conclude that the park has a hidden economic value. The values suggest that management resources should be continuously allocated for PGNP preservation and to develop recreation activities, specifically eco-tourism, as a means of developing the local areas in a sustainable way in full respect of the conservation goals, which are priority. Besides, the large estimated use value would still further suggest that undertaking major improvement work for the management of the existing natural facilities like the adoption of entry fees and per use-day fees would probably be economically and socially justifiable to guarantee more revenues for park management through user fees. This is particularly important at the present because the park administration struggles with accruing problems related to financing, human desertification, excessively rising demand for recreation activities and a deficit in educational and environmental information in the population in general. The budget of the Park is 13% (OECD 2001) of total expenditure the Nature Conservation

Institute (ICN) incurs in the management of all protected Portuguese areas[19]. The budget significantly increased in the 1990's largely reflecting the EU co-financing which accounts for 59% of the NPPG budget during the 1994-99 period (OECD 2001). But since 2003, it has fallen heavily due to the serious budgetary constraints the country currently faces. Accruing to Portuguese financing constraints, EU co-financing may also decrease as from 2006 onwards. This further demonstrates how the possibility of raising funds from private sources is advisable, such as user fees. Along with these financial problems, depopulation of rural areas in the interior renders even more difficult the task of managing the park because traditional agriculture and grazing practices helps strongly to preserve the landscape and natural habitats. Although eco-tourism activities are expected to offer a supplementary source of income to residents, eco-tourism demand must be carefully regulated to minimise the risk for accruing even further physical, biological or environmental damages. This kind of damage is one of the problems PGNP managers currently deal with.

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Notes

[1] Endogenous stratification refers to how in on site surveys the level of probability of a visitor being surveyed depends on his/her visit frequency to the site.

[2] A hurdle model like that applied by Santos Silva and Covas (2000) was also thought to be equally appropriate to our data although we did not apply it because too many parameters have to be precisely estimated for such a small sample size as was the case here. Further applications of count data hurdle models to recreation demand are Mullahy (1986), Creel and Loomis (1990) and Hellström (2005).

[3] We assume weak days of stay complementary with the exogenously set quality of the site which means that $\partial U / \partial q = 0$ when $d = 0$ (visitor does not care about the quality of a park he/she does not intend to visit). We further assume that all recreation activities are strongly separable including those produced in the Park by the visitor.

[4] Like Wilman (1987), we assume the individual to be indifferent to combinations of visit length j and visits yielding the same number of days.

[5] This assumption seems reasonable given that PGNP is the only national park existing in mainland Portugal. Furthermore, the national park category is only awarded when there are unique and/or rare ecosystems that deserve to be protected.

[6] For individuals travelling together, shared costs were apportioned to the respondent. The transport mode was taken into consideration.

[7] The per-km cost was dependent on technical characteristics of the vehicle and included fuel and toll costs.

[8] To avoid multiple-destination trip problems we took the origin of the trip to be the place the PGNP visitor was at the moment he took the decision to go to the Park. To avoid trip preferences, kilometres were exogenously calculated assuming the fastest and most accessible itinerary from origin to destination.

[9] The correlation coefficient between distance travelled and the on-stay number of days is significantly inferior to the unity (r = 0.04), which allows us to assume the exogenity of this variable with reference to the distance travelled (Rockel and Kealy 1991).

[10] To avoid lodging preferences, camping was considered as the minimum on-stay cost in the park. Only relevant costs were considered, such as camp site and parking charges, and the alveolus fees. Food was deemed irrelevant, because visitors have to eat regardless of their activity.

[11] Both time spent on the trip and on the stay were introduced into the demand function of recreation days in a composite way to surround some multicolinearity problems between the length of travel to the site and length of time spent on the site (Cesario et al 1970).

[12] We further assumed travel and on-site time costs to be the same across individuals, recreational activities and on-stay length (Cesario 1976).

[13] The opportunity cost of travel and on-site time has been one of the better discussed issues by those economists interested in the use of recreation or wilderness sites and remains an ongoing debate. See for instance Fletcher et al (1990); Ward and Beal (2000) to gain a more complete picture.

[14] This option seems to be the best in this case because interviewees declared incomes from other origins besides work. On the other hand, almost all individuals in the sample declared they were on vacation or that they were visiting the park over a long, bank holiday weekend period. Hence, it seemed implausible to apply the classical trade-off between leisure and work hours under these circumstances. We assumed that, in the absence of further individual information about their perception on the time issue, PGNP opportunity recreation time is equal to individual foregone utility, for non-

spending income and time on other alternative recreation activities, different to those of PGNP.

[15] We tested the results both without time cost and with time cost equal to 50% of RY per capita per hour.

[16] We also considered a 14th monthly payment for non-employees calculated on the base of the reported income-bracket.

[17] This is approximately 0.007% of the Portuguese GDP at market prices, 0.03% of the North Region's GVA, and 1% of the agricultural GVA of the same region.

[18] This is approximately 0.2% of the Portuguese GDP at market prices. 0.89% of the North Region's GVA, and 26% of the agricultural GVA of the same region.

[19] One National Park – II IUCN Category, 9 Nature Reserves – IV IUCN Category, 12 Natural Parks – V IUCN Category, 10 Classified Sites, 5 Natural Monuments and 3 Protected Landscapes.

Appendix

Non-nested specification tests

Test	Statistic	p-value	Evaluation
	Initial Models		
Santos Silva [1]	8.264	.004	Rejects the Generalized Poisson at 1%
Santos Silva[2]	8.918	.003	Rejects the Gen. Negative Binomial at 1%
Vuong	1.630	.103	Both Models are possibly inadequate at 10%
	Altered at 8 & 10		
Santos Silva [1]	6.132	.013	Rejects the Generalized Poisson at 2%
Santos Silva [2]	8.247	.004	Rejects the Gen. Negative Binomial at 1%
Vuong	1.948	.051	Both Models are possibly inadequate at 5 % Rejects the Gen. Negative Binomial at 10%
	Altered at 8		
Santos Silva [1]	4.331	.037	Rejects the Generalized Poisson at 4%
Santos Silva [2]	8.918	.003	Rejects the Gen. Negative Binomial at 1%
Vuong	1.737	.082	Both Models are possibly inadequate at 5 % Rejects the Gen. Negative Binomial at 10 %
	Grouped Data		
Santos Silva [1]	-0.239		Test not valid[3]
Santos Silva[2]	240.108	.000	Rejects the Gen. Negative Binomial at 1%
Vuong	3.643	.000	Rejects the Gen. Negative Binomial at 1%

[1] Restricted Generalized Poisson under the null.

[2] Restricted Generalized Negative Binomial under the null.

[3] Given that under the null the test statistic has a Chi-square distribution the negative value could indicate a rejection. However, given that the figure is close to zero it may also be due to sampling error.

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Table I Descriptive Statistics

Variable	Mean	Stand Deviation	Max	Min
ND	5.284	3.573	18.000	1.000
€RCDS	50.479	30.604	215.266	12.098
ADR	22.329	15.138	90.000	1.000
AGE	30.926	10.871	66.000	18.000
ED	6.984	2.225	10.000	2.000
€RY	799.080	482.880	3452.265	143.844

Note: observations = 243

Table II Frequencies of the Number of Recreation Days in the PGNP during the Visit

ND_i	Count	%	ND_i	Count	%
1	24	9.88	10	13	5.35
2	39	16.05	11	3	1.23
3	25	10.29	12	3	1.23
4	36	14.81	13	1	0.41
5	27	11.11	14	2	0.82
6	15	6.17	15	8	3.29
7	17	7.00	16	1	0.41
8	27	11.11	17	0	0.00
9	1	0.41	18	1	0.41

Table III Estimates Results of Grouped TGP and TGNB

Variable	GTGP	RGTGPI	RGTGPII	GTGNB	RGTGNB
			Estimates for β		
Intercept	1.330 (6.65)	1.481 (12.51)	1.547 (13.70)	1.582 (3.55)	1.651 (9.37)
RCDS (10^2€)	-0.602 (-1.87)	-0.607 (-1.91)	-0.516 (-2.08)	-1.483 (-2.27)	-1.902 (-2.75)
RY (10^3€/per capita)	0.120 (0.78)	0.151 (1.06)		0.455 (1.75)	0.539 (3.09)
ADR (days)	0.010 (3.28)	0.010 (3.72)	0.010 (3.73)	0.014 (4.46)	0.013 (4.55)
AGE (years)	0.003 (0.74)			0.003 (0.57)	
ED (years)	0.012 (0.60)			-0.018 (-0.78)	
			Estimates for γ		
Intercept	-1.633 (-1.54)	-2.777 (-5.36)	-2.903 (-5.45)	0.029 (0.01)	-2.032 (-2.29)
RCDS (10^2€)	0.084 (0.06)			3.626 (3.72)	3.815 (3.09)
RY (10^3€/per capita)	0.709 (1.38)	0.616 (1.82)	0.659 (1.82)	0.536 (0.28)	
ADR (days)	0.000 (0.06)			-0.053 (-1.45)	-0.045 (-1.88)
AGE (years)	-0.036 (-1.41)			-0.052 (-0.67)	
ED (years)	-0.211 (-2.40)	-0.174 (-2.17)	-0.158 (-2.05)	-0.122 (-0.87)	
Log Likelihood	-160.692	-161.830	-162.340	-186.703	-188.411
Likelihood Ratio test		2.28 (0.810)	3.30 (0.771)		3.42
RESET Test		5.34 (0.07)	2.76 (0.251)		6.66 (0.036)

Note: t-statistics are in parentheses. Likelihood ratio tests the restricted model against the respective unrestricted model. The RESET test of no joint misspecification of $\beta' x$ and $\gamma' x$ has a $\chi^2(2)$ under the null. For both tests p-values are in parentheses.

Table IV Point and 90% Confidence Interval Estimates for CS per visitor per day (CS_D) (2005 euros)

		Delta Method		*Simulated*	
	CS	Lower	Upper	Lower	Upper
TGP	136.48	80.99	191.98	99.32	217.57
TGNB	145.42	81.06	209.78	104.19	239.77
Altered at 8 TGP	147.34	77.62	217.06	102.53	258.57
Altered at 8 TGNB	156.65	77.19	236.11	107.65	282.37
RGTGPII	193.74	40.68	346.80	115.95	448.13
RGTGNB	52.58	21.16	84.00	35.73	97.45